

Duration of Useful Survival of the Isolated Radula Protractor of the Gastropod *Busycon canaliculatum*

BY

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(3 Plates)

IN A NUMBER OF EXPERIMENTAL designs gastropod buccal muscles are expected to be active in isolation for periods of hours or days. For instance, in bioassay procedures, radula muscle complexes have been kept in a water bath for 48 hours (FEDER & LASKER, 1968). Similarly, the isolated radula protractor of *Busycon (Busycotypus) canaliculatum* (Linnaeus, 1758) has been used for hours in a sucrose gap (HILL, GREENBERG, IRISAWA & NOMURA, 1970) or for periods of up to 20 hours in a sea water bath (HILL, 1970). It becomes appropriate to ask whether physiological variations should be attributed to experimental manipulations or to decline in the condition of the preparation. A suitable parameter for assessing decline of the preparation should be maximal for the condition of the preparation at a given time (*i. e.*, not susceptible to variation in threshold or post-tetanic potentiation) and yet should not excessively fatigue the preparation. Sub-fusion tetanus thus seemed preferable to twitches or to complete tetanus.

METHODS

The isolated radula protractor was set up in a bath of aerated natural sea water (HILL, MARANTZ, BEATTIE & LOCKHART, 1968) maintained at 9° or 10° C. Isotonic contractions were recorded on a smoked drum. An electronic stimulator was used to deliver shocks between two chlorided silver electrodes, one tied to the odontophore end of the muscle and the other in the sea water at a point corresponding to the radula end of the relaxed muscle. The standard stimulus was 80 V (40 ma) for 8 msec.

RESULTS

At the temperatures used it was found that tetanus fusion was consistently complete at 5 shocks per second (Figure

1A) and that there was no mechanical wave summation at 0.2 shocks per second (Figure 1B). The lowest frequency at which summation was evident was 0.5 shocks per second (Figure 2) and shortening was doubled by the incomplete tetanus at 1.3 shocks per second (Figure 2). After a few preliminary trials with repeated tetanization over long periods of time, 1 shock per second was chosen as standard frequency, since it consistently remained below tetanus fusion frequency as long as the muscle was viable.

Pairs of muscles from the same animal were set up in identical baths and a rocking key was used to determine whether the stimulus was sent to one muscle or the other. The same lever arm ratio was used throughout and shortening was reported simply as mm on the drum. One muscle was stimulated for one minute at hourly intervals from 9 A. M. to 5 P. M. for 6 days. During the first 5 days (Figure 3) shortening fluctuated during the day between 45 mm and 70 mm. On the sixth day, shortening fluctuated between 15 mm and 20 mm during the day. The control muscle was stimulated for one minute at hourly intervals between 1 P. M. and 5 P. M. of the sixth day only. Shortening fluctuated between 45 mm and 75 mm. When the muscle was stimulated at short intervals (10 minutes) it was found that no significant deterioration in performance could be measured over one day. The latter experiment was repeated nine times with consistent results.

DISCUSSION AND SUMMARY

It may be said with confidence that the isolated radula protractor does not deteriorate significantly in its ability to respond to stimulation over the period of one day. Over longer periods, a repetitively stimulated muscle may deteriorate more quickly than a control maintained in sea water. After six days, the repetitively stimulated muscle attained a maximal 75 mm shortening.

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Explanation of the Plates

Figure 1: A. Stimulation of the isolated radula protractor at 1, 2, 3, and 5 shocks per second.

B. Stimulation of the isolated radula protractor at 0.2, 0.5, and 1 shock per second.

Figure 2: Increase in tetanus fusion between 0.5 and 1.3 shocks per second.

Figure 3: During a six-day period the isolated radula protractor was tetanized at 1 shock per second for one minute at hourly intervals ten times each day. Ordinate, shortening in mm on the drum. Abscissa, days. Representative examples of kymograph records inset. Lightly shaded area in bars represents amplitude of individual sub-fusion responses.